



CAVANAUGH

Stewardship Through Innovation

Why Percent Water Loss as a Metric Isn't Cutting It in Rate Cases But What Are The Alternatives?



Relevant Roles:

Chair, AWWA Water Loss Outreach Subcommittee
IWA Water Loss Specialist Group, US Representative
Chief Innovation Officer, Cavanaugh

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What's Driving Change?

U.S. Has Reached 52 Percent Drought



By Sara Jerome
@sarmje

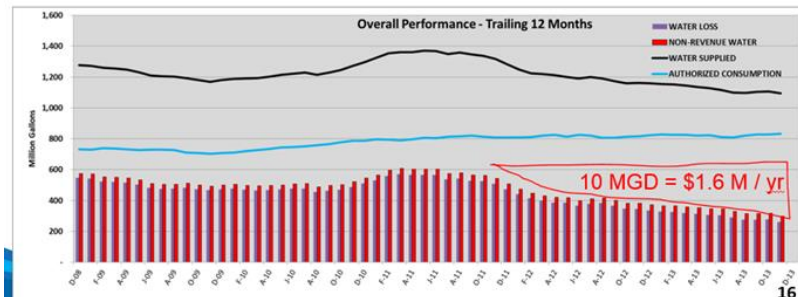
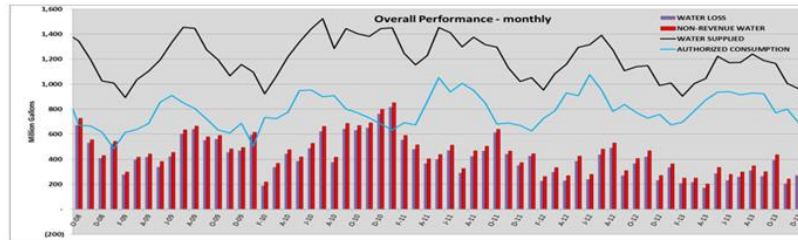
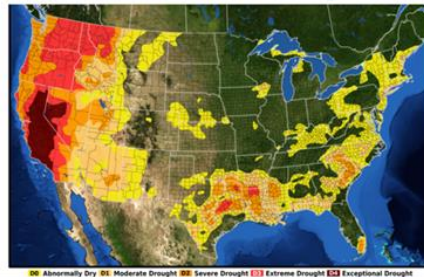
It's official: Most of the U.S. is facing drought conditions.

More Than Half of the United States Is Abnormally Dry or Officially in a Drought

U.S. Drought Monitor | September 8, 2015

Issued: 9/10/15 | Data: NDMC | Map: The Vane | thevane.gawker.com | @wxdam

"The U.S. Drought Monitor, which analyses every Tuesday and releases every Thursday, says that 52.00% of the United States — including Alaska, Hawaii, and Puerto Rico — is suffering from a lack of precipitation and is now abnormally dry or stuck in a drought," Gawker [reported](#).



Senate Bill No. 555

October 9, 2015

Contact: Melissa Jones, (916) 651-4003

Governor signs Wolk drought preparedness, renewable energy bills
Bills improve water management & conservation, increase use of renewable energy programs

SACRAMENTO—Governor Edmund G. Brown Jr. signed into law a measure by Senator Lois Wolk (D-Davis) to improve water management and conservation in California, and another bill to boost participation in programs enabling utility customers to receive part of their electricity from renewable energy sources.

Today, Brown signed Senate Bill 555, which requires all urban water suppliers in California to conduct annual water loss audits to detect leaks and breaks in their water distribution systems and submit the results to the Department of Water Resources for public review. The measure would also require the State Water Resources Control Board to develop performance standards to minimize water loss in the water agencies' distribution systems.

"The fastest and cheapest way to save water is to identify and recover the water lost on a daily basis in our urban areas," Wolk said. "It is estimated that we could save hundreds of thousands of acre-feet this way. Every drop counts."



CHAPTER
to add Section 10008.14 to the Water Code, relating to
CONSERVATION AND WATER SUPPLY
10008.14. Urban retail water suppliers water loss
management program. (a) Every urban retail water supplier
reg law requires the state to achieve a 20% reduction in
of capital water use in California by December 31, 2020,
the state to make incremental progress towards this
reducing per capita water use by at least 10% on or before
or 31, 2015. Existing law requires each urban retail water
to develop urban water loss targets and an interim water
target, in accordance with specified requirements.
It would require each urban retail water supplier, on or
October 1, 2017, and on or before October 1 of each year
to submit a completed annual water loss audit to the
the previous calendar year or previous fiscal year as
of by rules adopted by the Department of Water Resources
from January 1, 2017, and updated as provided. The bill
requires the Department to post all validated water loss audit
on its Internet Web site in a manner that allows for
for water agency water suppliers and to make those reports
for public viewing. This bill would require the Department
to technical assistance to public urban retail water suppliers
on detection programs. The bill would require the State
American Central Board, on or before January 1, 2018,
after July 1, 2020, to adopt rules requiring urban retail
suppliers to meet performance standards for the volume of
loss. This bill would require the board to contribute up to
to funding available for the 2016-17 fiscal year towards
procuring water loss audit report validation assistance for urban
retail water suppliers.

Challenging Reporting

New Jersey

DEP is responsible to make an “annual enumeration” of water loss by water systems serving greater than 500 persons that have “unaccounted for water” greater than 15%, triggering potential compliance action against such utilities. Actions might include directing revised Plans **to act on reducing losses**, more frequent Plan submission, and/or set a time frame for reduction of losses to occur.

Kentucky

The agency with jurisdiction over water loss reporting is the Kentucky Public Service Commission (PSC). The PSC has set forth laws and regulations for investor owned water utilities and to fulfill these laws and for the purposes of rate setting, utilities must determine their UFW percentage, and it **must not exceed 15%** of total water produced and purchased (807 KAR 5:066 Water – Section 6 Water Supply Measurement).

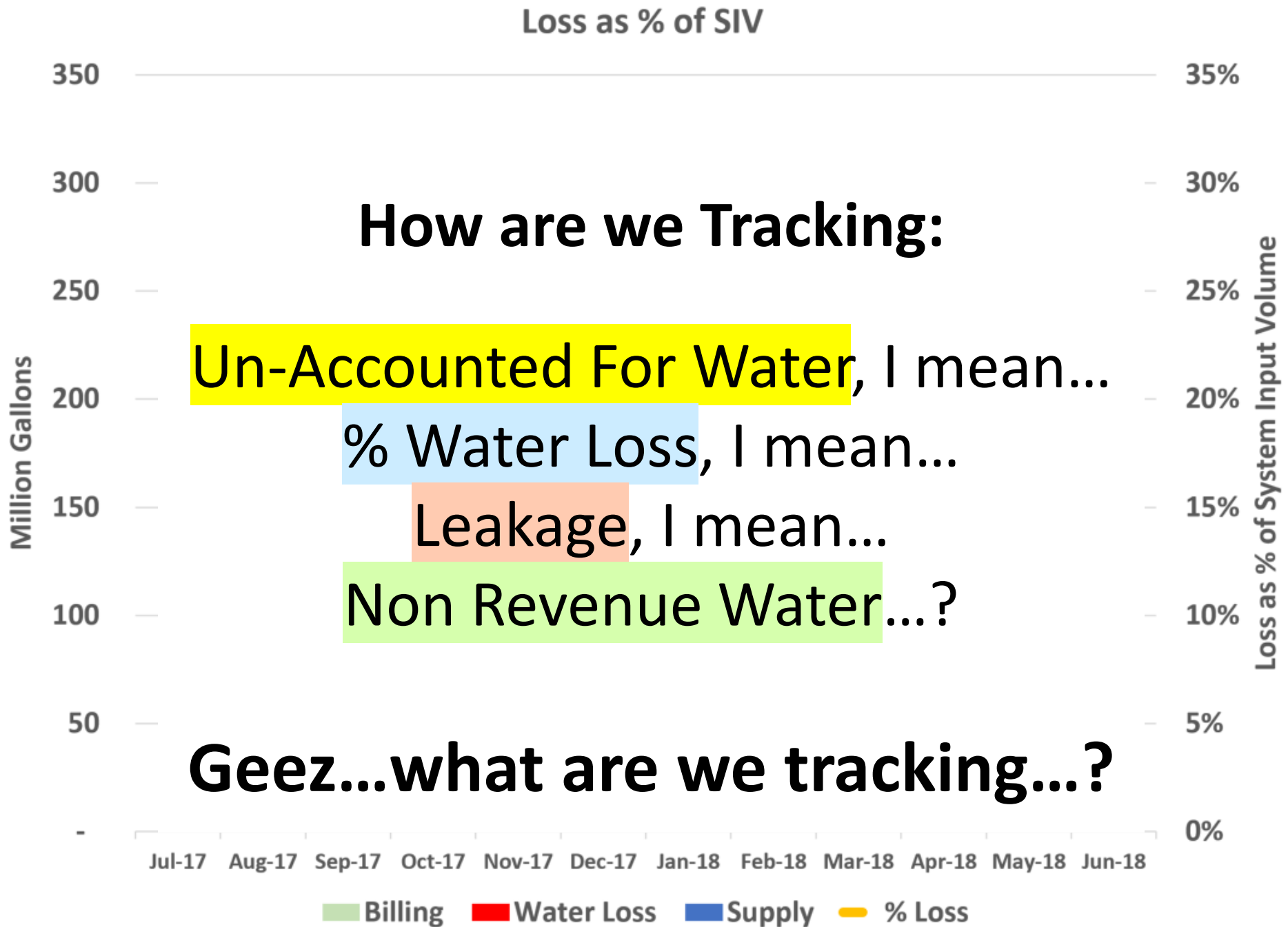
COMMONWEALTH OF KENTUCKY
BEFORE THE PUBLIC SERVICE COMMISSION

In the Matter of:

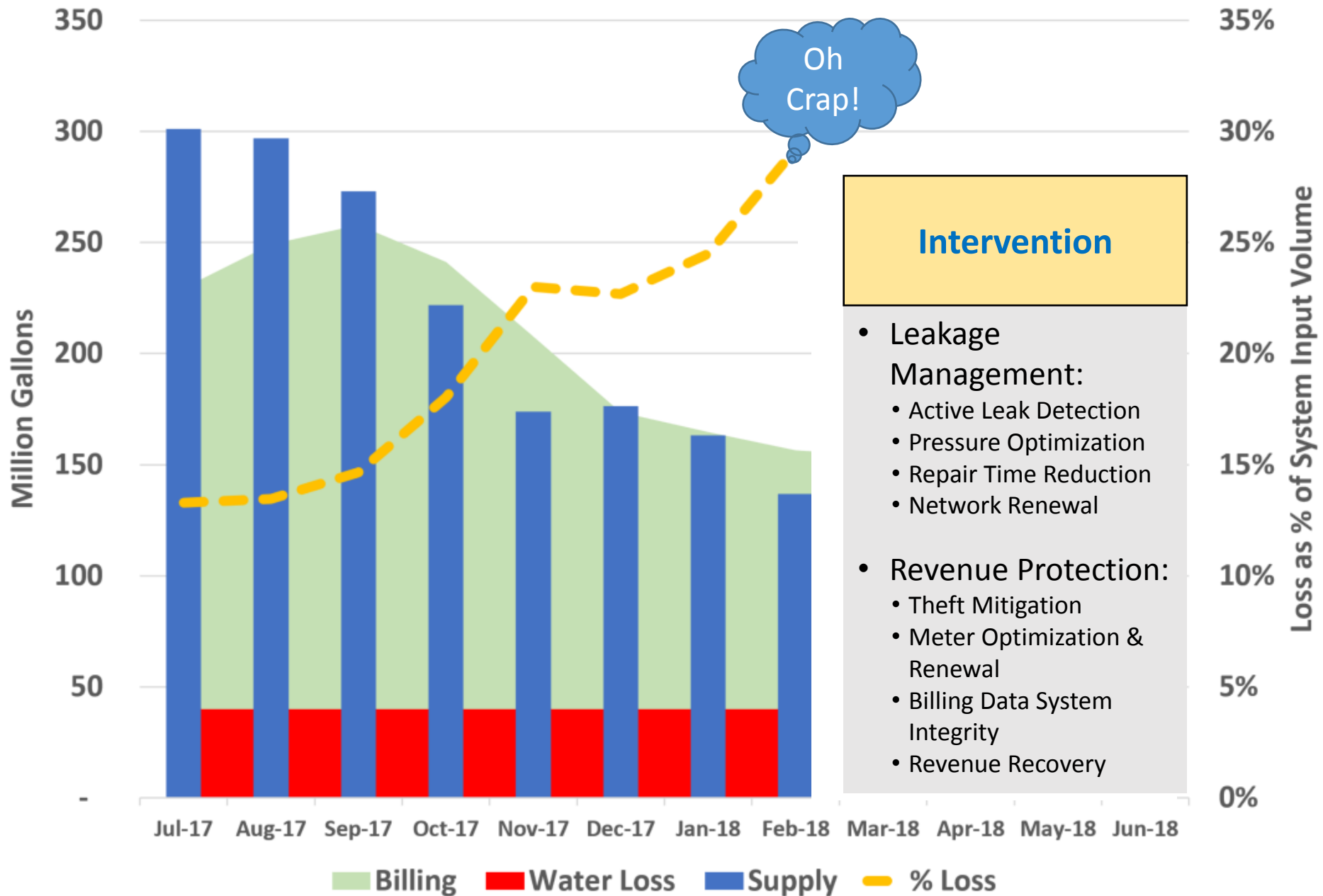
ELECTRONIC INVESTIGATION INTO SOUTHERN)	
WATER AND SEWER DISTRICT MANAGER)	CASE NO.
DEAN HALL ALLEGED FAILURE TO COMPLY)	2019-00084
WITH KRS 278.160, KRS 278.170, KRS 278.300,)	
807 KAR 5:066, AND 807 KAR 5:095)	

manager.⁴ As general manager, Mr. Hall is Southern District's chief executive officer, as defined by KRS 74.040.

This formal investigation and show cause action has its genesis in Southern District's request for a rate adjustment in Case No. 2018-00230.⁵ The Staff Report filed in that case stated that Southern District had outstanding loans for which it did not obtain Commission approval as required by KRS 278.300; that Southern District reported significant unaccounted-for water loss in excess of the 15 percent limit pursuant to 807 KAR 5:066, Section 6(3); and that Southern District had not complied with its tariff



Loss as % of SIV



Right Tool, Wrong Problem?



Starting to Question Reporting

COMMONWEALTH OF KENTUCKY
BEFORE THE PUBLIC SERVICE COMMISSION

In the Matter of:

ELECTRONIC INVESTIGATION INTO THE)	
MEASURING, RECORDING, AND REPORTING)	CASE NO.
OF WATER LOSS BY KENTUCKY'S)	2018-00394
JURISDICTIONAL WATER UTILITIES)	

ORDER

Upon its own motion, the Commission initiates this investigation to review the adequacy of the methods used by Kentucky's jurisdictional water utilities to measure, record, and report their water loss. As part of this investigation, the Commission will provide guidance to jurisdictional water utilities regarding the reporting of water loss, as well as provide an updated water loss form for measuring and tracking this loss.



COMPREHENSIVE WATER LOSS REDUCTION PLAN

3.f. Unaccounted-for Water Plan

A detailed description of the MVWA's Leak Remediation Program was provided as Exhibit C.2. It is also attached to this document.

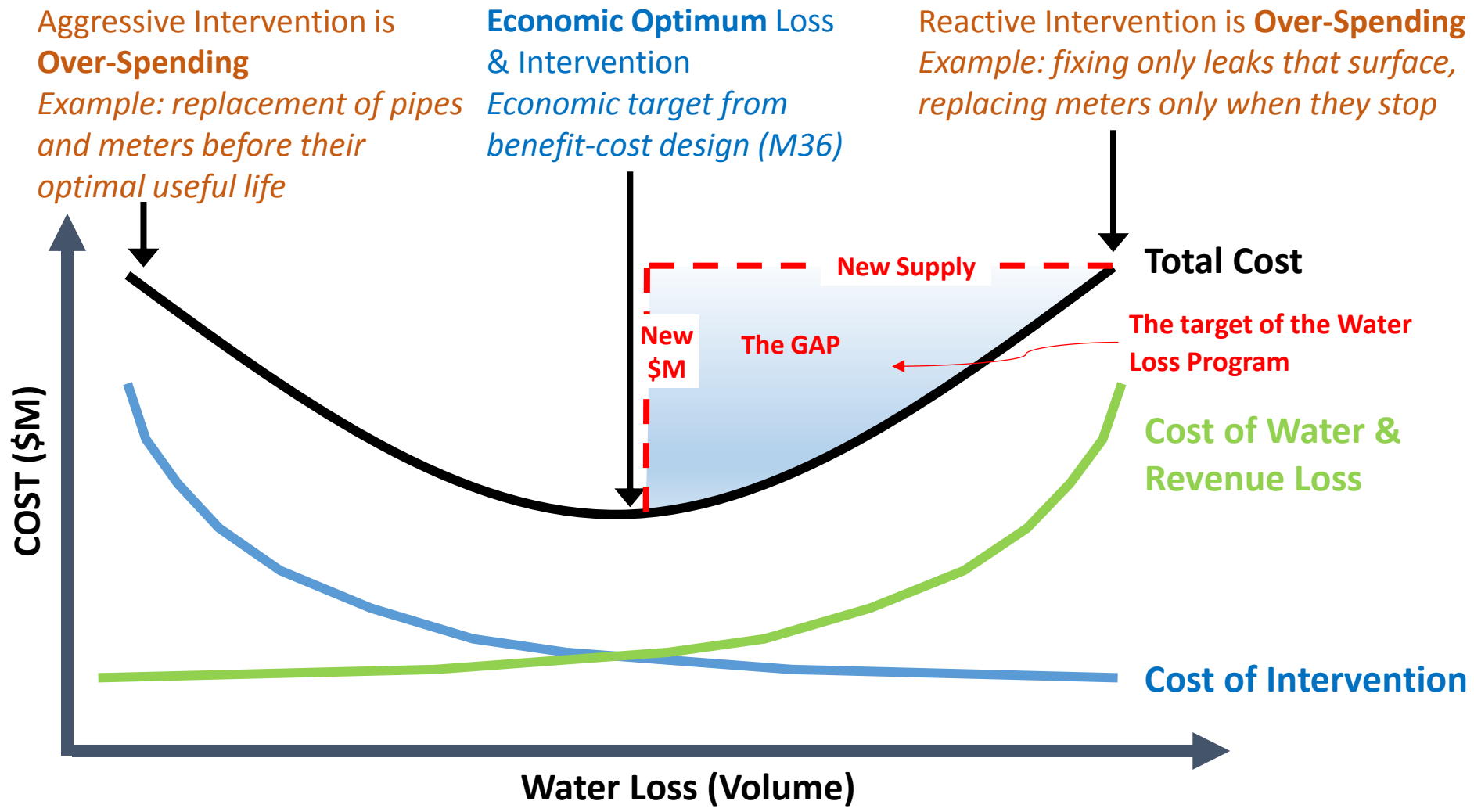
"AWWA [American Water Works Association] has recommended against use of the term 'unaccounted-for' water and the 'unaccounted-for water percentage.' Instead, it recommends use of the term Non-revenue Water and the array of performance indicators included in the IWA/AWWA Water Audit Method."ⁱ

According to the AWWA, "Revenue Water" includes both metered and unmetered billed consumption. "Non-revenue Water" includes: both metered and unmetered unbilled consumption, unauthorized consumption, customer meter inaccuracies, systematic data handling errors, leakage in transmission and distribution mains, storage leaks and overflows from water storage tanks, and service connection leaks up to the meter.

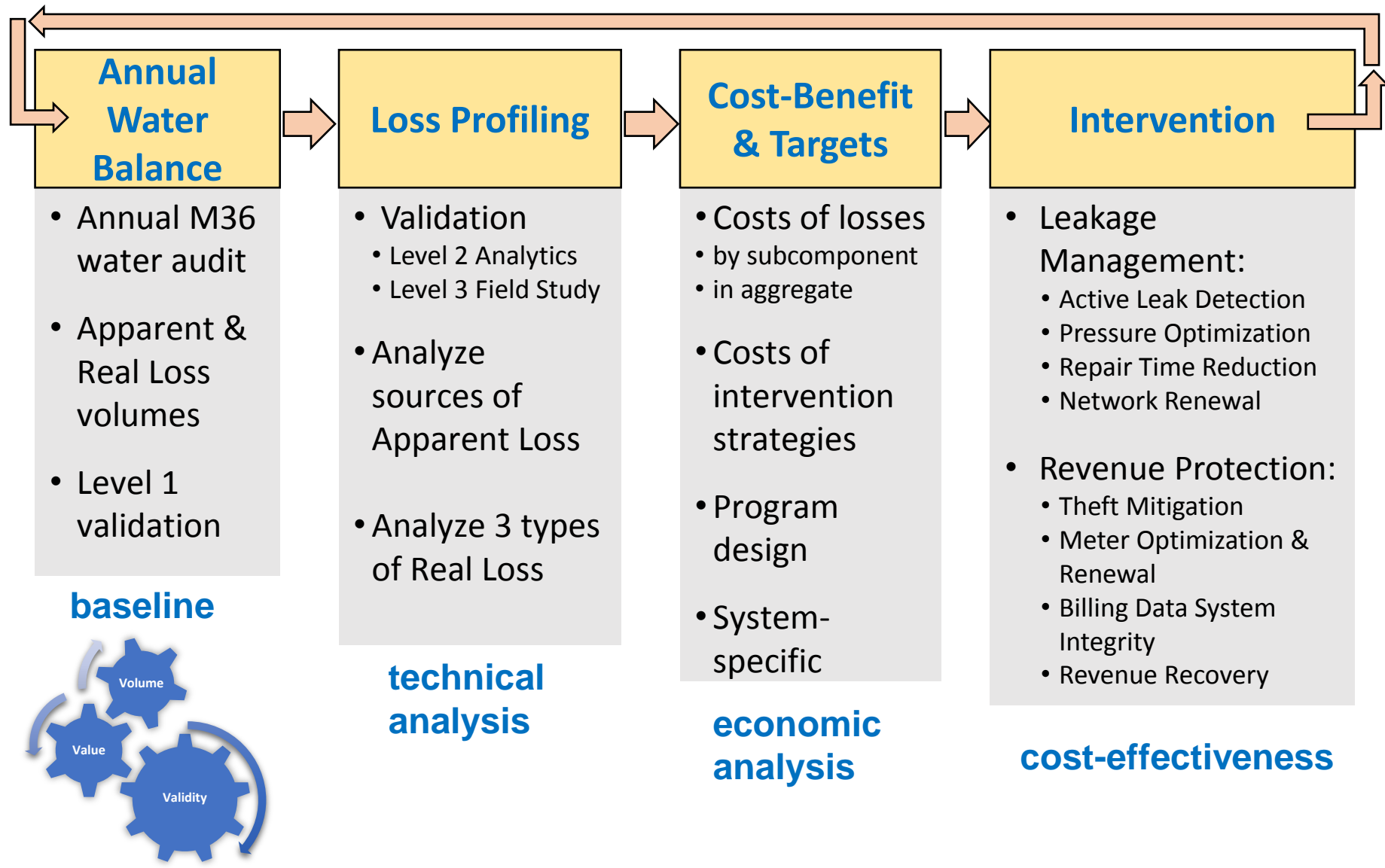
The MVWA cannot provide a schedule for reducing system unaccounted-for water to 15% because water leaks are dynamic and varied. Controlling water losses is a continuous process. ***The MVWA is strongly committed to reducing water losses and will have augmented tools within the next three to four years that will help quantify and reduce water losses.***

AWWA M36

Economic Optimum



The Big Picture: Economic Intervention



AWWA M36

U.S. State Programs

Washington

Pilot, 10 Systems, 9 Months

Colorado

Full Scale, 165 Systems, 2 Years

Wisconsin

Pilot, 6 Systems, 6 Months

Utah

2 Pilots, 12 Systems, 6 Months

Massachusetts

60 Systems, 2 Years

California

Full Scale, 460 Systems, 2 Years

Arizona

Pilot, 6 Systems, 6 Months

Hawaii

Full Scale, 100 Systems, 4 Years

New Mexico

Full Scale, 134 Systems, 12 Months

North Carolina + South Carolina

Regional Basin, 19 Systems, Multi-year

Georgia

Full Scale, 230 Systems, 5 Years




Florida

Pilot, 10 Systems, 12 Months

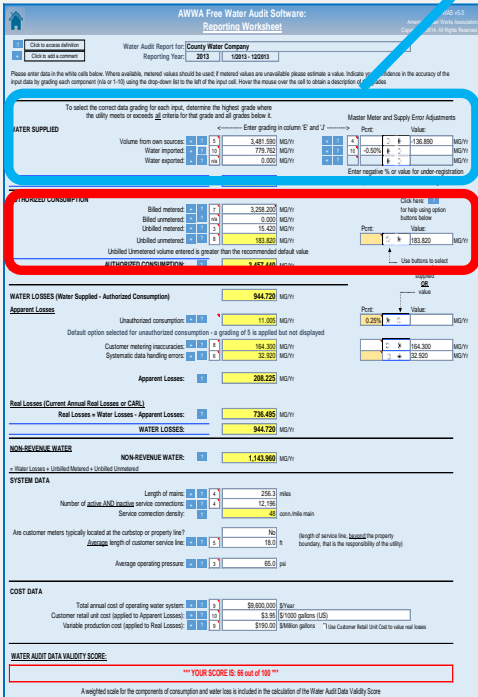
Extra Slides

For questions during panel

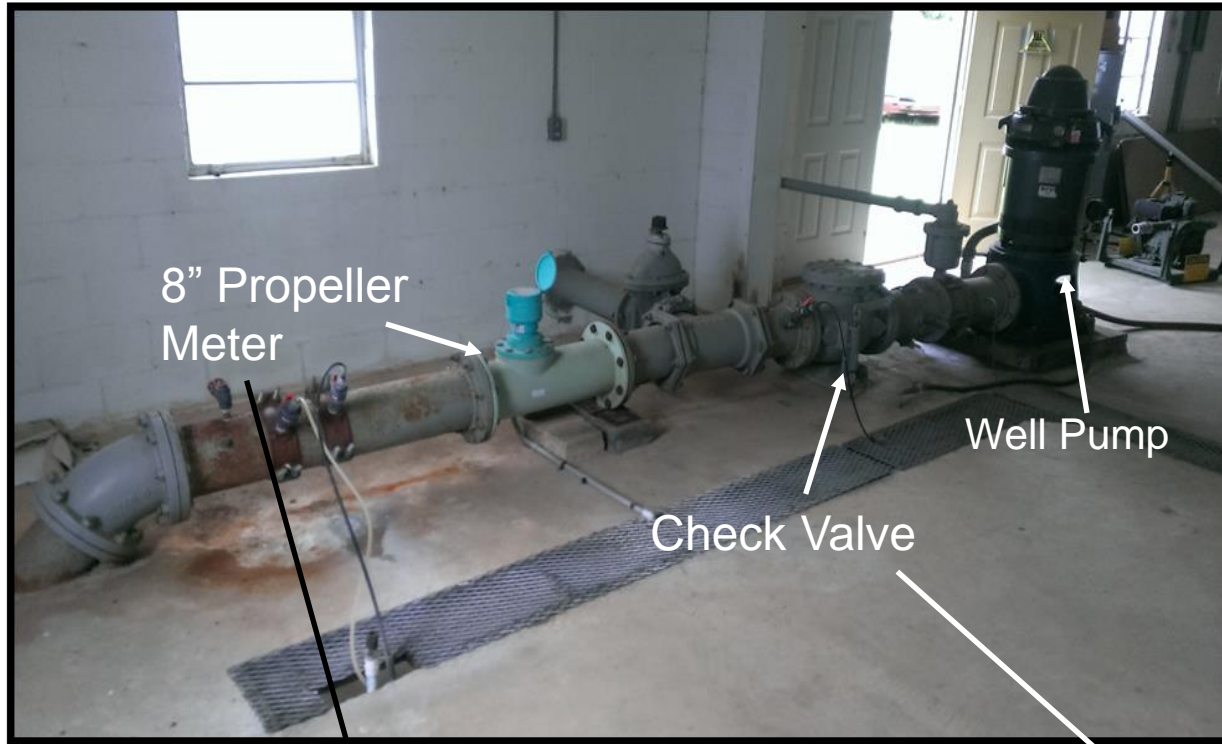
AWWA M36 Water Balance

SYSTEM INPUT VOLUME	AUTHORIZED CONSUMPTION	BILLED AUTHORIZED CONSUMPTION	BILLED METERED CONSUMPTION	REVENUE WATER
			BILLED UNMETERED CONSUMPTION	
		UNBILLED AUTHORIZED CONSUMPTION	UNBILLED METERED CONSUMPTION	\$\$\$ NONREVENUE WATER 
			UNBILLED UNMETERED CONSUMPTION	
	WATER LOSSES	\$\$\$ APPARENT LOSSES	CUSTOMER METER INACCURACIES	
			UNAUTHORIZED CONSUMPTION	
			DATA HANDLING ERRORS	
		 REAL LOSSES 		

Accuracy in the Water Balance

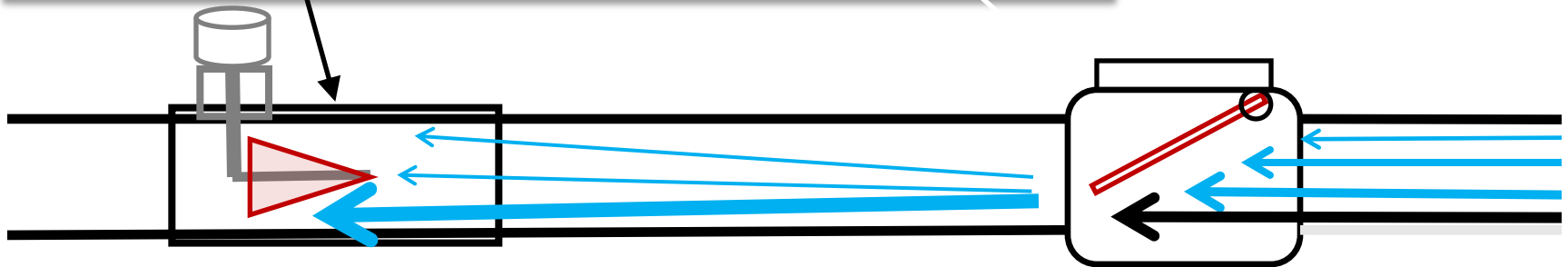
	BILLED AUTHORIZED CONSUMPTION		REVENUE WATER
	BILLED METERED CONSUMPTION		
SYSTEM INPUT VOLUME	BILLED UNMETERED CONSUMPTION		NONREVENUE WATER
	UNBILLED METERED CONSUMPTION		
AUTHORIZED CONSUMPTION	UNBILLED UNMETERED CONSUMPTION		CUSTOMER METER INACCURACIES
	UNBILLED AUTHORIZED CONSUMPTION		
WATER LOSSES	UNAUTHORIZED CONSUMPTION		UNAUTHORIZED CONSUMPTION
	APPARENT LOSSES		
REAL LOSSES	DATA HANDLING ERRORS		
	REAL LOSSES		

Accuracy in the Water Balance



Accuracy results from MFR test bench: 99.5%

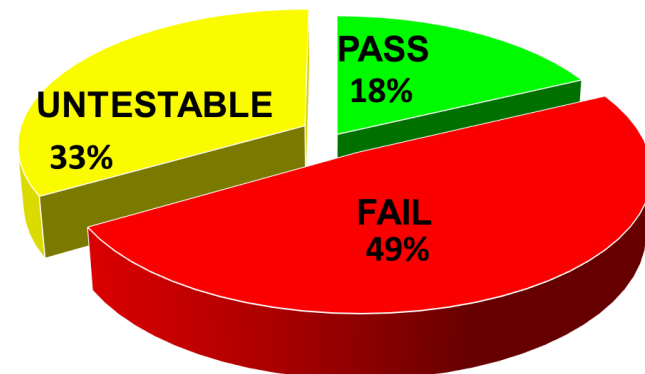
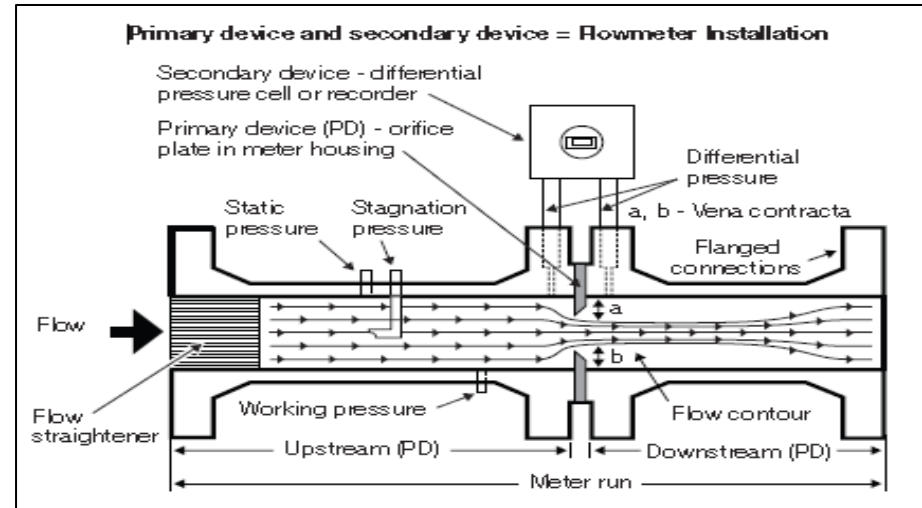
Accuracy results from in-situ test: 142.2%



Accuracy in the Water Balance

Example of Water Pumping Data Gaps and

8/15/2012, hrs	High Service Pumping Rate, mgd actual flow	High Service Pumping Rate, mgd raw recorded data
0:00	8.69	8.69
1:00	8.65	8.65
2:00	8.32	8.32
3:00	8.11	8.11
4:00	7.94	0
5:00	8.02	0
6:00	8.44	0
7:00	8.98	0
8:00	9.34	0
9:00	9.25	0
10:00	9.17	0
11:00	9.12	9.12
12:00	9.27	9.27
13:00	9.22	9.22
14:00	9.08	9.08
15:00	8.99	8.99
16:00	9.14	9.14
17:00	9.18	9.18
18:00	9.25	9.25
19:00	9.22	9.22
20:00	8.82	8.82
21:00	8.78	8.78
22:00	8.75	8.75
23:00	8.71	8.71
0:00	8.68	8.68
Total	212.43	151.29
Average	8.85	6.30
Difference		2.55



Accuracy in the Water Balance

Locatio	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
26478	413	369	430	387	27437		1375	536	513	441	381	455

3" meter

Locatio	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
130558	4	5	4	10	419	13	31	34	25	5	14	7

1" meter

Location	1	2	3	4	5	6	7	8	9	10	11	12	Grand Total
36534	1	44	309										354
110936	430	17			0	0	0	0	0	1	1	1	450
31014	4	4	3	6	1	0	9	7	7	8	2	409	460
139728	345	0	0	0	0	1	6	22	12	0	0		386
43636	0	0	1	0	1	1	0	0	0	0	0	282	285
1464	7	244	3			0	2	5	3	4	4	5	277
124422	2	262	2	1	2	17	22	16	10	11	2	3	350
43992	6	7	3	5	0	2	0	0	0	0	0	255	278
16600	0	149	15	0									164
115394	11	0	5	3	6	10	58	100	183	120	52		548
130224	7	4	1	0	0	28	1	0	42	211	0	3	297
2906	19	25	12	7	6	8	6	13	10	8	8	214	336

5/8" meters

Location	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
88964	2	3	2	3	169	915	939	657		700	7	2
93972	574	438	512	513	439		1374	1048	1092	1245	842	1217
88954	75	80	59	65	267	877	924	630		826	66	56

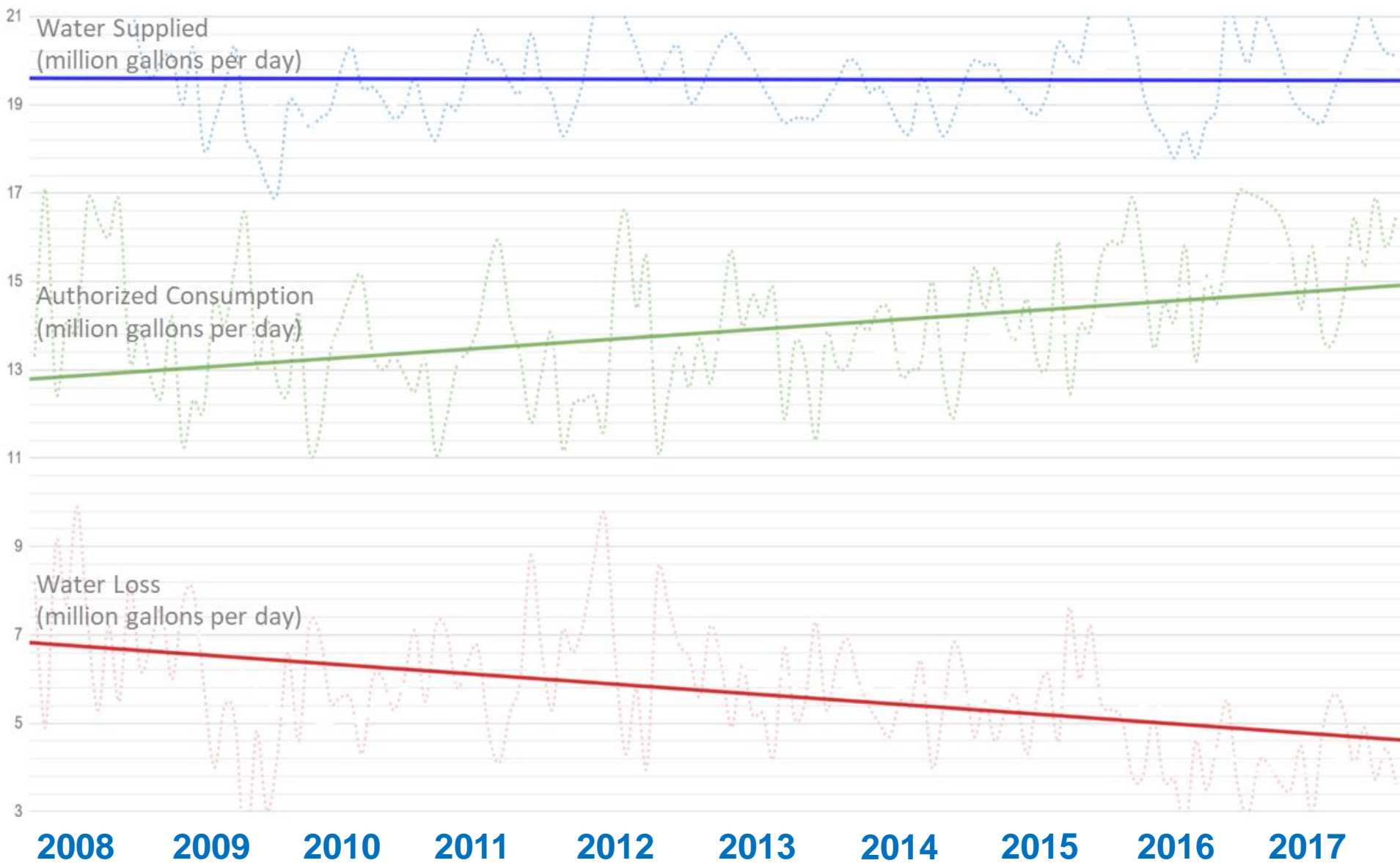
2" meter

2" meter

3" meter



The Big Picture: Sustainability



Relevance: Impact on Bond Ratings



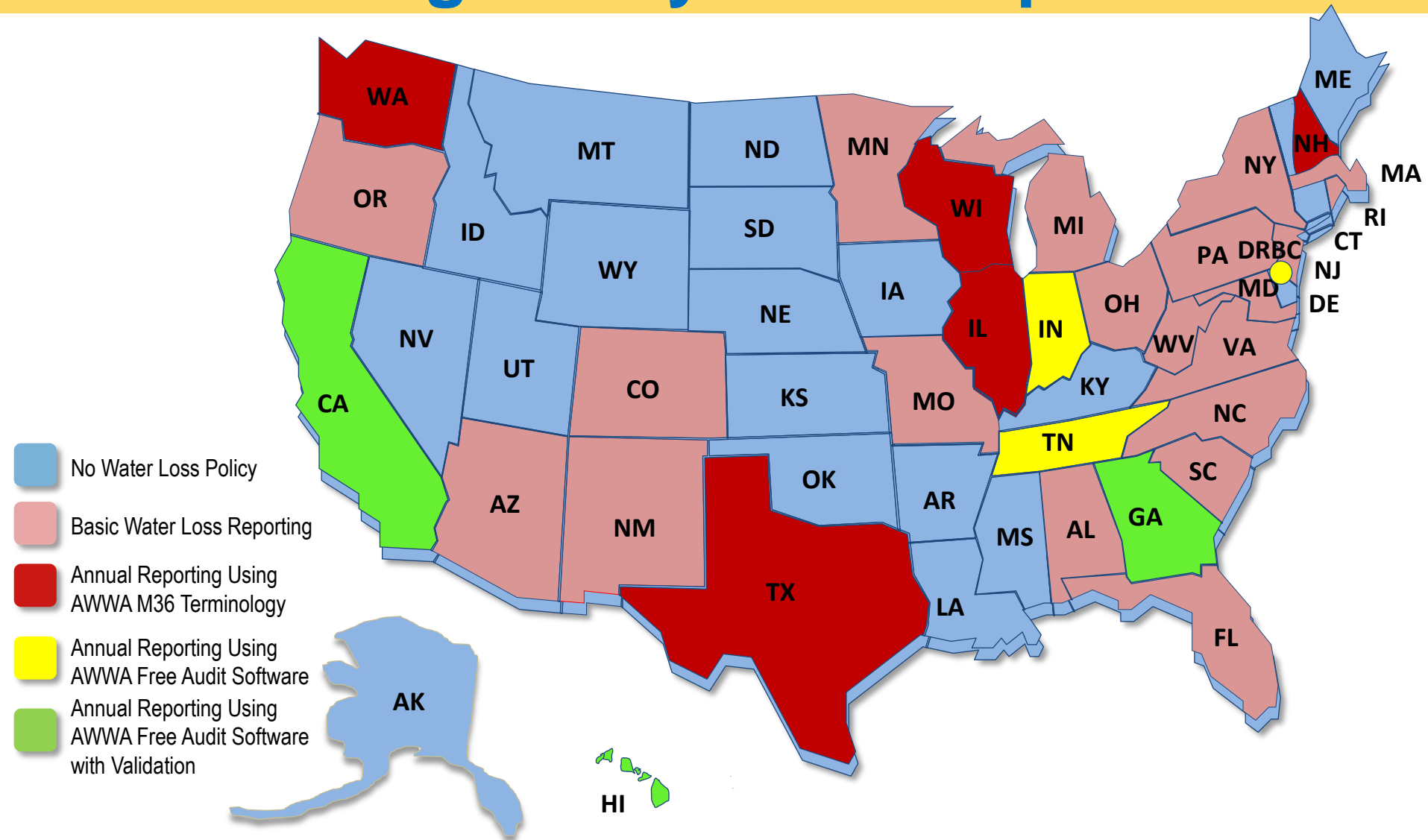
Strong – Utility has performed a water audit consistent with the AWWA M-36 methodology on an annual basis for the prior five years. The utility has a well-structured and documented Non-Revenue Water Management Program that includes ongoing leak detection work and annual accuracy testing of finished water meters and a representative sample of customer meters.

Good – Utility has performed a water audit consistent with the AWWA M-36 methodology on an annual basis for the prior three years. The utility has engaged in specific components of a Non-Revenue Water Management Program such as periodic finished water meter testing, accuracy testing of samples of customer meters and active leak detection.

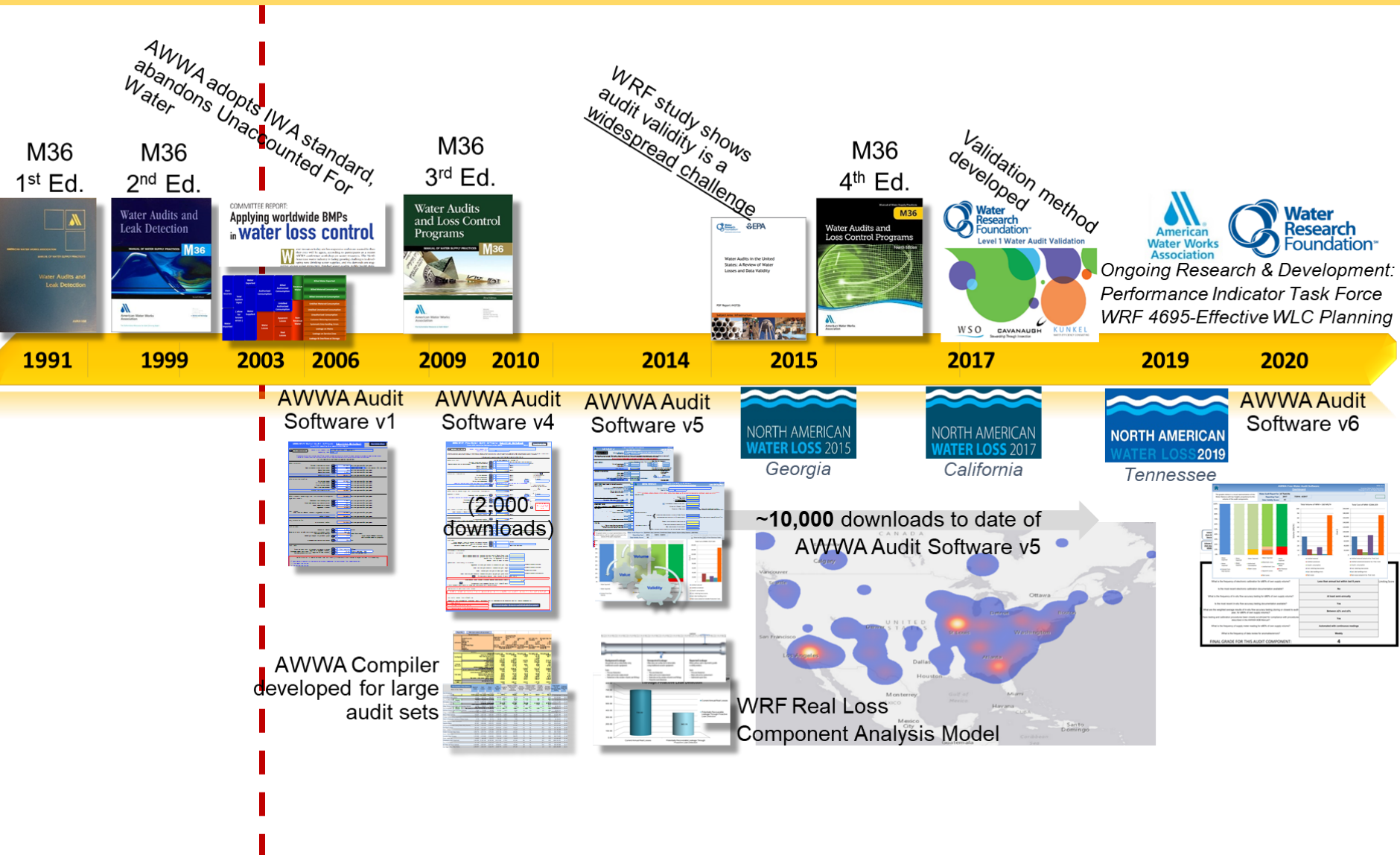
Standard – Utility has performed a water audit consistent with the AWWA M-36 methodology but does not do so on an annual basis. The utility tracks some basic water loss information on a monthly basis but does not have an active Non-Revenue Water Management Program.

Vulnerable – Utility has not performed a water audit consistent with the AWWA M-36 methodology and does limited tracking of some basic water loss information on a monthly basis. This information is generally reported on a percentage of volume-supplied basis.

AWWA M36 Regulatory Landscape



AWWA M36 Methodology



Measuring Performance: The Three Vs

Volume

- MG per Year
- gal/conn/day
- Leakage Index

Value

Validity

- Annual Cost (\$/year)
- Cost by component
- Economic Loss Index

AWWA Free Water Audit Software: Reporting Worksheet

Water Audit Report for: Northern San Leandro Combined Water Sewer Storm Utility District (0007900)

Reporting Year: 2013 1/2013 - 12/2013

Please enter data in the white cells below. Where available, metered values should be used. If metered values are unavailable, please estimate a value. Indicate your confidence in the accuracy of the input data by grading each component (via 0-10) using the drop-down list to the left of the input cell. Hover the mouse over the cell to obtain a description of the grades.

All volumes to be entered as: MILLION GALLONS (MG) PER YEAR

To select the correct data grading for each input, determine the highest grade where the utility meets or exceeds all criteria for that grade and all grades below it.

WATER SUPPLIED

Volume from own sources	Enter grading in column 'E' and 'F' →	Point	Value	MG/Yr
Water imported	1000.000	1	100.000	MG/Yr
Water exported	100.000	1	25.000	MG/Yr
WATER SUPPLIED:			825.000	MG/Yr

AUTHORIZED CONSUMPTION

	Enter grading in column 'E' and 'F' →	Point	Value	MG/Yr
Billed metered	700.000	1	700.000	MG/Yr
Billed unmetered	50.000	1	50.000	MG/Yr
Unbilled metered	10.313	1	10.313	MG/Yr
Unbilled unmetered	10.313	1	10.313	MG/Yr
AUTHORIZED CONSUMPTION:			760.313	MG/Yr

WATER LOSSES (Water Supplied - Authorized Consumption)

	Enter grading in column 'E' and 'F' →	Point	Value	MG/Yr
Apparent Losses	64.688	1	64.688	MG/Yr
Real Losses (Current Annual Real Losses or CARL)	49.617	1	49.617	MG/Yr
WATER LOSSES:			64.688	MG/Yr

NON-REVENUE WATER

	Enter grading in column 'E' and 'F' →	Point	Value	MG/Yr
Non-Revenue Water	75.000	1	75.000	MG/Yr

SYSTEM DATA

Length of mains: 100.0 miles

Number of service AND inactive service connections: 1,000

Service connection density: 10 conn./mile main

Are customer meters typically located at the curbside or property line? Yes (length of service line beyond the property boundary, that is the responsibility of the utility)

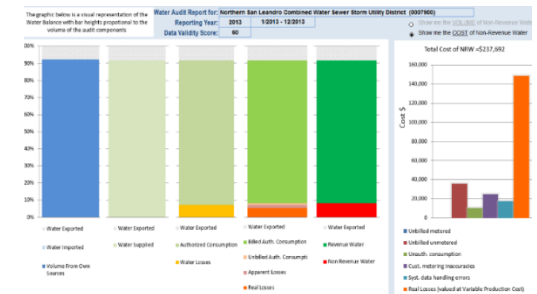
Average length of customer service line has been set to zero and a data grading score of 10 has been applied

Average operating pressure: 60.23 psi

COST DATA

	Enter grading in column 'E' and 'F' →	Point	Value	\$/Year
Total annual cost of operating water system	\$1,000,000	1	\$1,000,000	\$/Year
Customer retail unit cost (applied to Apparent Losses)	\$3.50	1	\$3,500.00	\$/1,000 gallons (USD)
Variable production cost (applied to Real Losses)	\$3,000.00	1	\$3,000.00	\$/1,000 gallons

Use Customer Retail Unit Cost to value real losses



- Water Audit Data Validity Score
- 95% Confidence Limits
- Key Data Input Grades

Team Engagement





**American
Water Works
Association**



**NORTH AMERICAN
WATER LOSS 2019**

NASHVILLE, TENNESSEE
DECEMBER 3-5

Save The Date

Resources

WRF study shows
audit validity is a
widespread challenge



www.awwa.org

M36 Manual 4th Edition

www.waterrf.org

Level 1 Water Audit Validation Manual

AWWA Audit
Software v5



NORTH AMERICAN
WATER LOSS 2015
Georgia

NORTH AMERICAN
WATER LOSS 2017
California

NORTH AMERICAN
WATER LOSS 2019
Tennessee

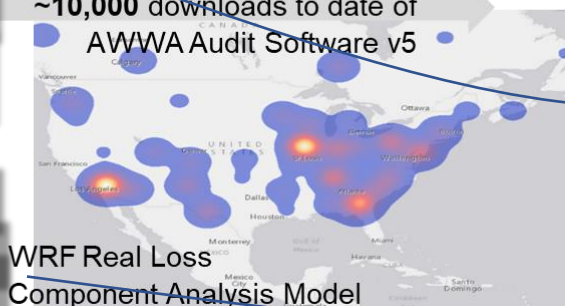
AWWA Audit
Software v6



www.awwa.org/waterloss

NAWL 2019

~10,000 downloads to date of
AWWA Audit Software v5



WRF Real Loss
Component Analysis Model

www.awwa.org/waterlosscontrol

Free Water Audit Software v5.0

www.waterrf.org

Real Loss Component Analysis
Model